Naval Aviation Crew Resource Management (CRM) Initiative

Human Factors QMB/Training Improvements Working Group Brief

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COMSEACONWINGPAC

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Crew Resource Management (CRM) Initiative

- **Naval Air Board Human Factors ESC**
  - **Naval Air Board Human Factors QMB**
    - **Training Improvements Working Group**
      - Initiatives to reduce skill-based and judgment errors:
        - **CADS Beta Test** (standardized data collection, crew feedback, and performance measurement)
        - **Integrated CRM** event-based curriculum (emphasis on situational awareness/decision making)
        - **Advanced Flight Instructor skills** (performance assessment/coaching)
        - **Decision Skills Training** (emphasis on critical thinking)

CRM Goals

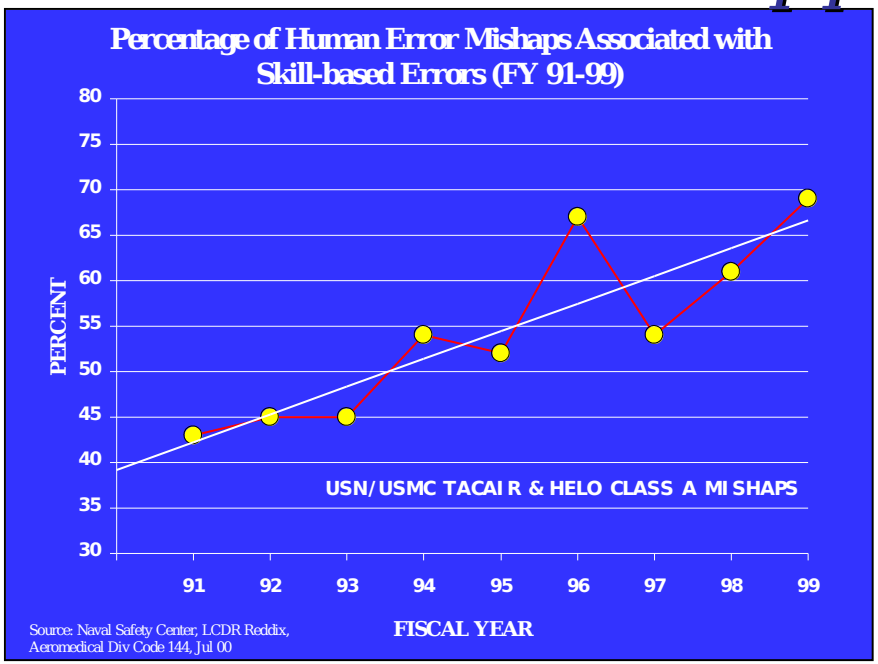
- Reduce mishap rate caused by HF & skill-based errors:
  - Provide aircrews with more realistic, defined training experiences and standards
  - Standardized procedures
- Improve mission performance:
  - Measurable evaluation and improved feedback adapted to each type model aircraft across Air Combat Training Continuum
  - Validate and improve effectiveness of Training and Readiness Matrices

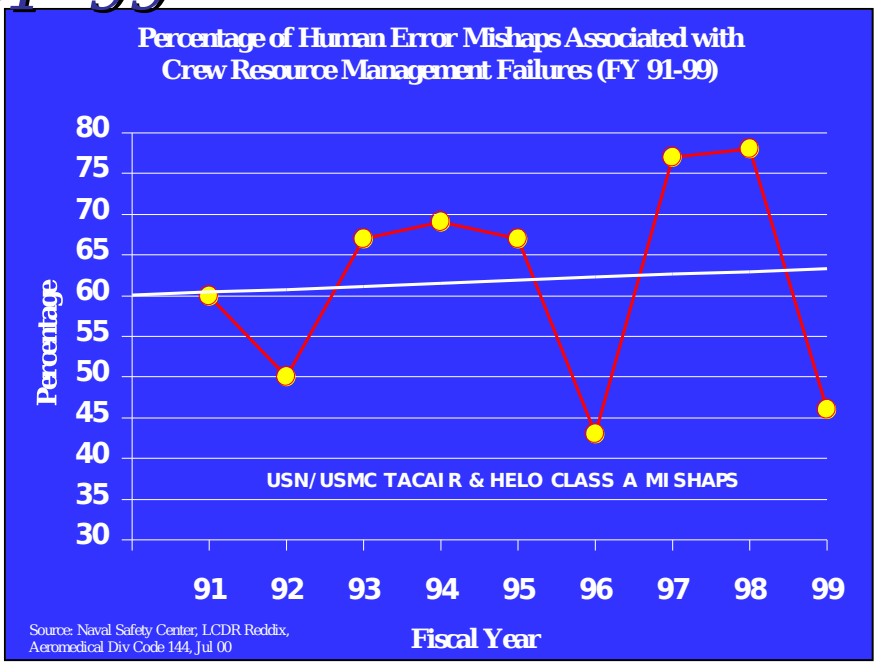
* CRM = Crew Resource Management

Skill-based & CRM Errors

Naval Aviation Mishaps

FY 91- 99



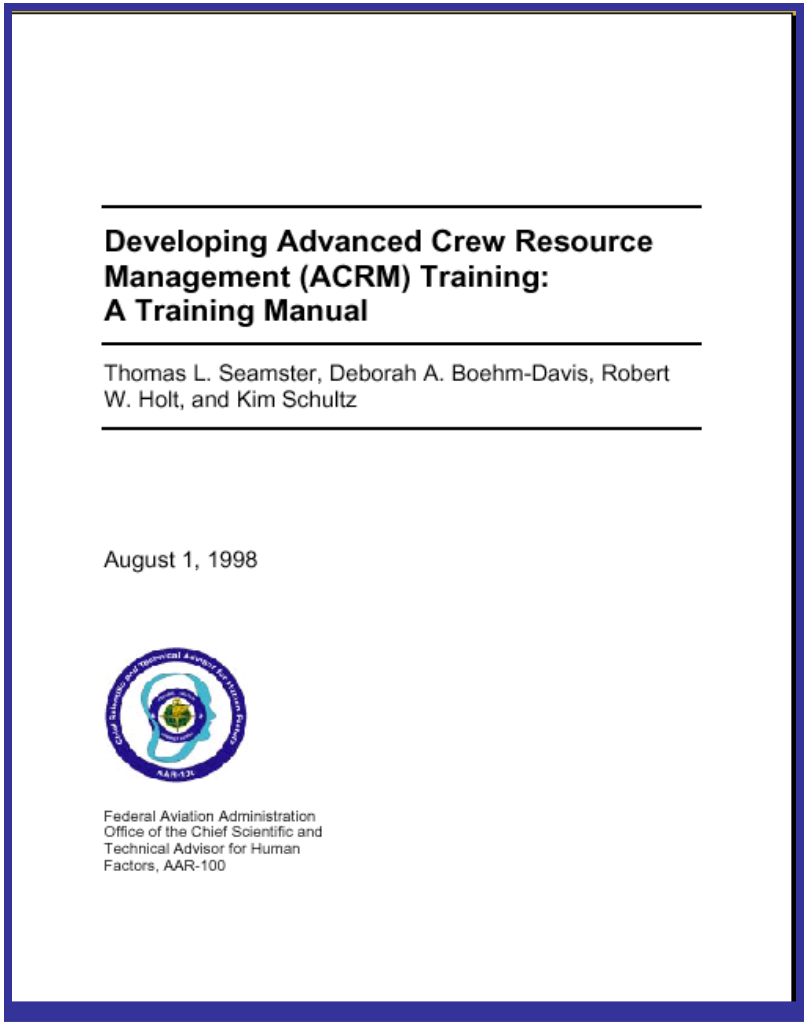


CRM Elements

- CRM Elements
  - Operational Risk Assessment & Management
  - Aircraft Flight Control
  - Communication Skills
  - Decision Processes & Skills
  - Situational Awareness
  - Tactical and Standard Operating Procedures
- Integrated CRM elements vice stove-piped:
  - NATOPS procedures and checklists
  - Training curriculum and evaluation

* CRM = Crew Resource Management

FAA ACRM Training



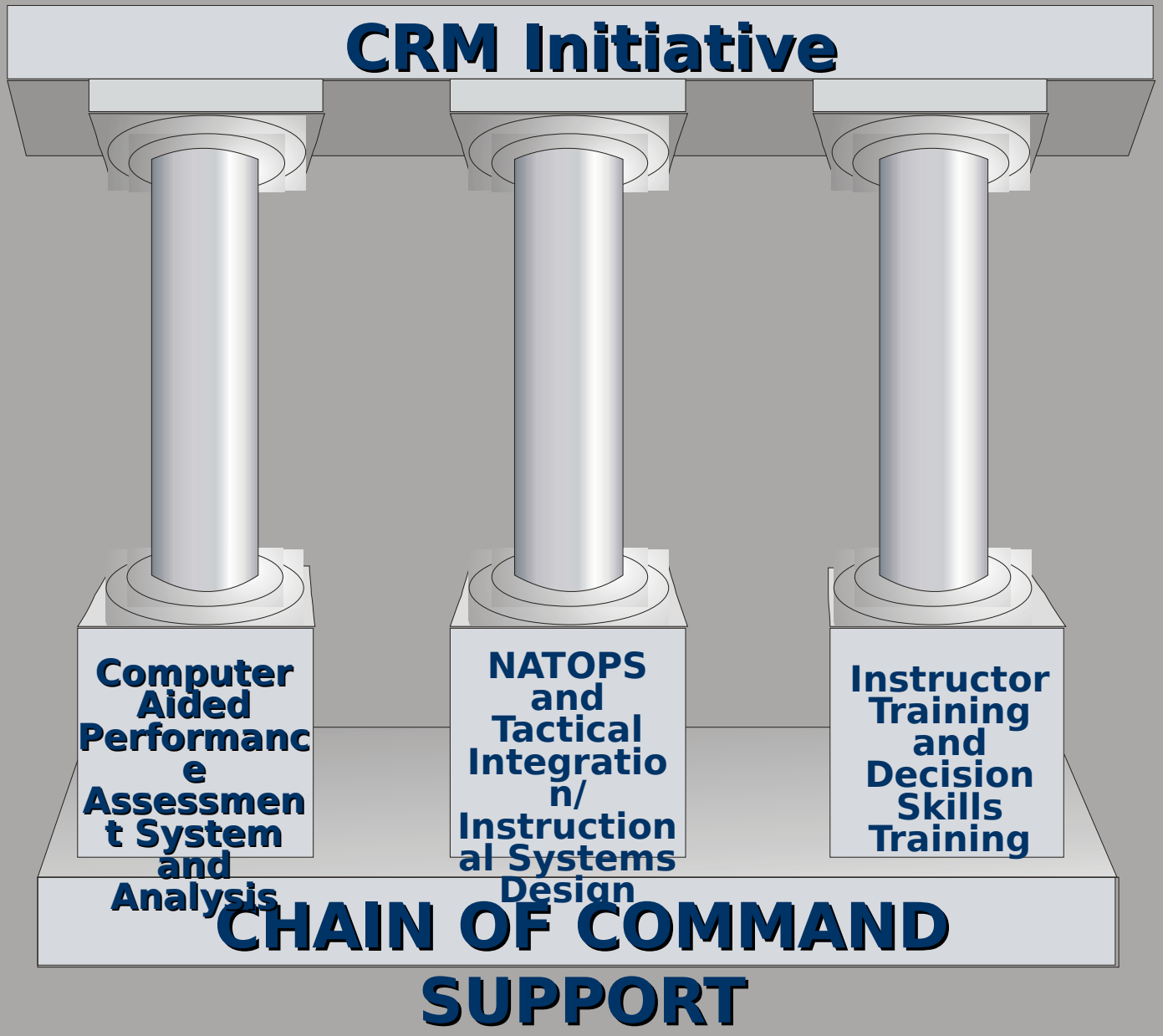
Developing Advanced Crew Resource Management (ACRM) Training: A Training Manual

Thomas L. Seamster, Deborah A. Boehm-Davis, Robert W. Holt, and Kim Schultz

August 1, 1998

Federal Aviation Administration
Office of the Chief Scientific and Technical Advisor for Human Factors, AAR-100

*ACRM = Advanced Crew Resource Management


CRM Initiative
Computer Aided Performance Assessment System and Analysis
NATOPS and Tactical Integration/ Instructional Systems Design
Instructor Training and Decision Skills Training
CHAIN OF COMMAND SUPPORT

CADS™

- **CADS ™ Registered trademark of ER Labs for commercial digital playback system in simulators:**
  - COTS technology - digital recording, storage, playback of flight & tactics (VS)
  - Beta system at VS-41 (FRS) since 1997
  - HSL-41 (FRS) system installed 1998
  - Airline beta tests (Northwest, Delta)
  - Navy Installs in work (simulators):
    - HSL-40 (Mayport)
    - COMSEACONWINGLANT VAQ 139 (FRS)

CAPAS/CADS™

CAPAS - Computer-Aided Performance Assessment System (Navy version)

- Mission Need Statement - CNO approved (May 99)
- Operational Requirements Document (ORD)
  - CINCPACFLT endorsed to NAVAIR (Mar 00)

- **Required Capability (Simulator):**
  - Record audio, video & data (flight & tactics)
  - Debrief & evaluation (subjective & objective)
  - Analysis (immediate and long term) (objective)
  - Archive & edit
- ***Potential for aircraft use***

CAPAS/CADS™ Current Capability

- **Digitally records entire simulator event:**
  - Cockpit, aircraft, flight & tactics (VS) performance data
  - Crew audio and video
  - Aircraft aspect and tactical plot
- **Instructor digitally 'marks' places while recording event using *Interface Device***
  - Can return instantly to digital marks during debrief, improving fidelity and focus of debriefs
  - Marks become reference for later analysis of CRM performance

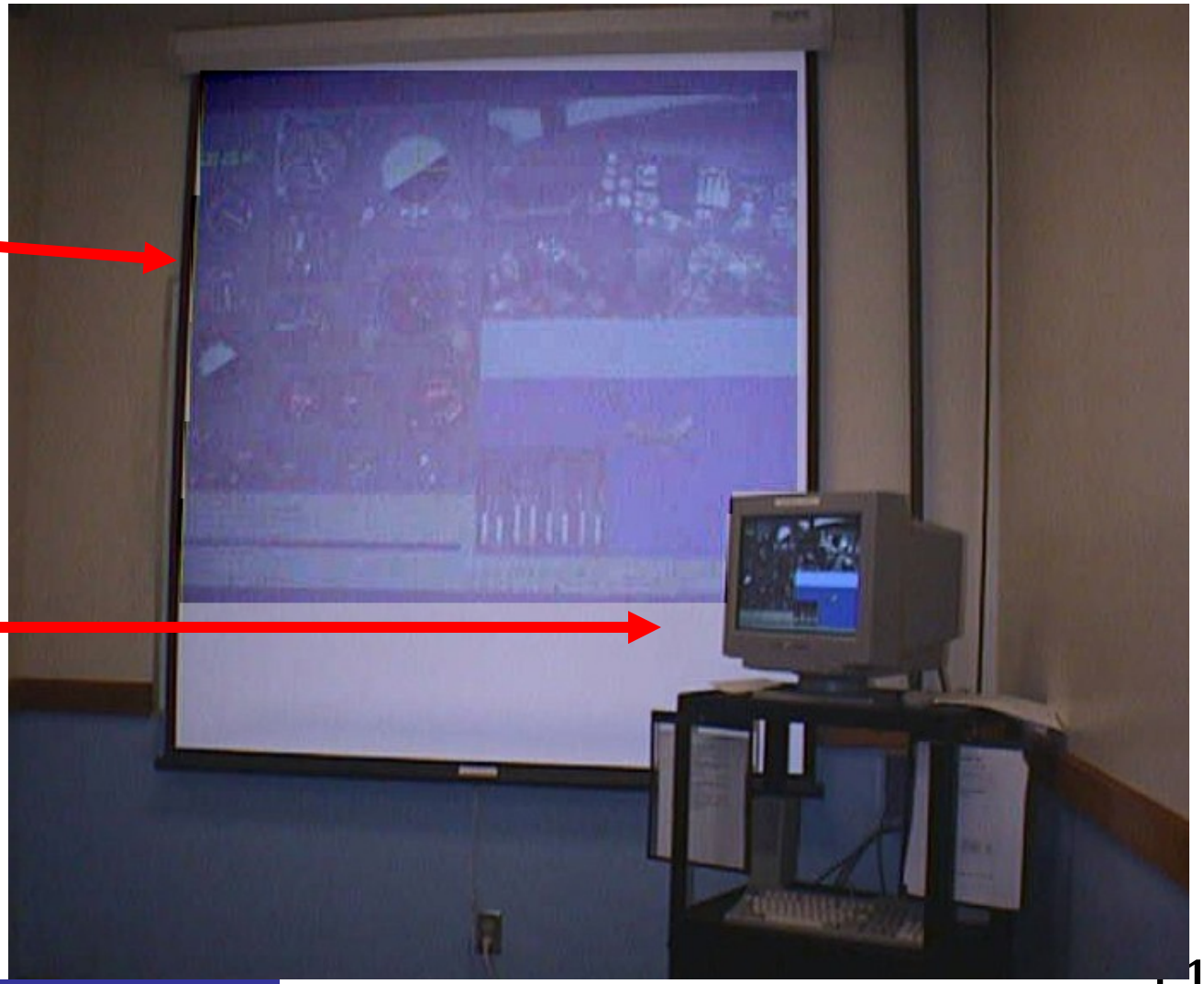
* CAPAS = Computer-Aided Performance Assessment System

VS-41 Debrief Room

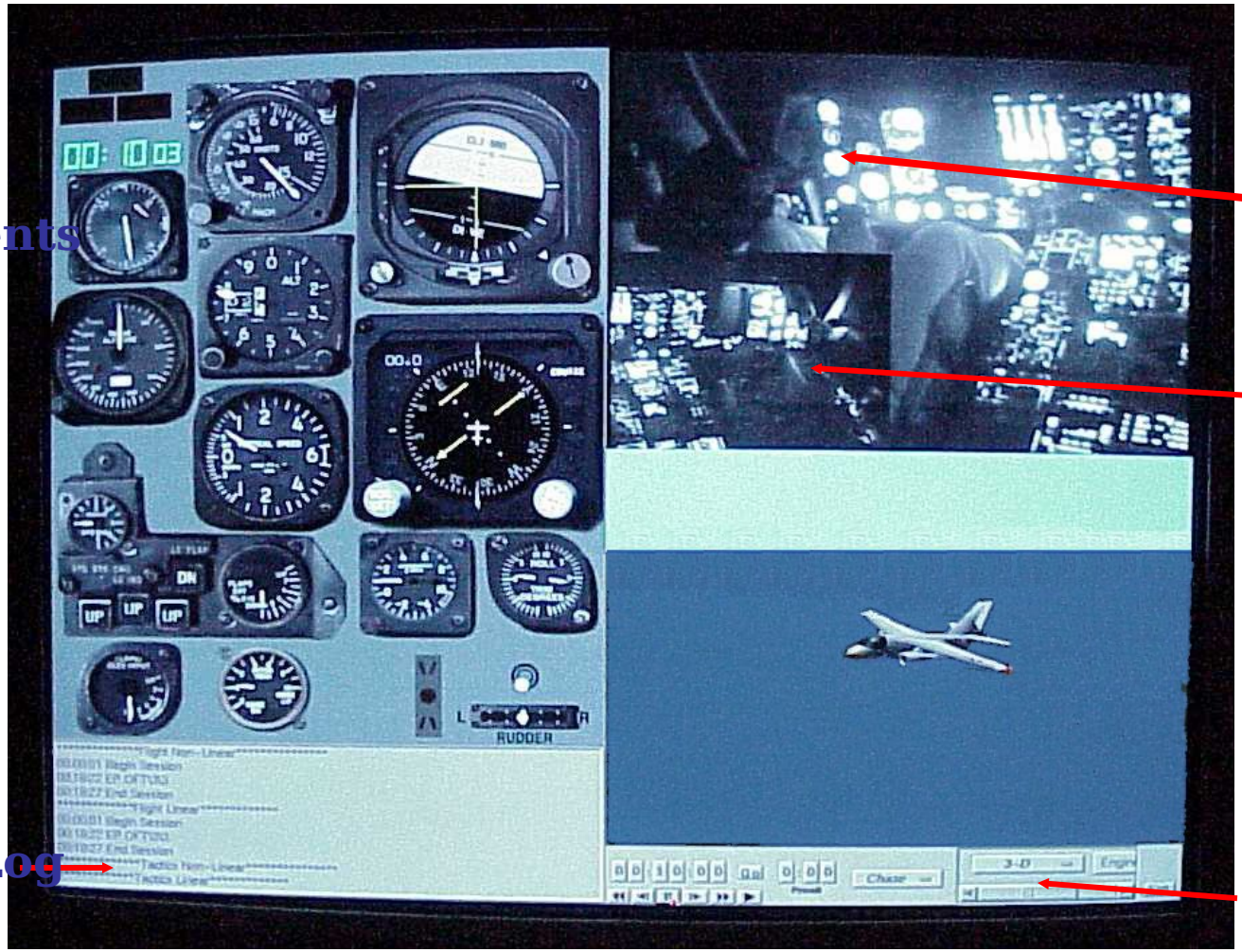
CAPAS/CADS™

Big screen display

Monitor & PC



Sample CAPAS/CADS™ Display



Cockpit Instruments

IR Cockpit Video Pilot

COTAC

Views

- **Chase plane**
- **Tower**
- **LSO**
- **Tactical plot**

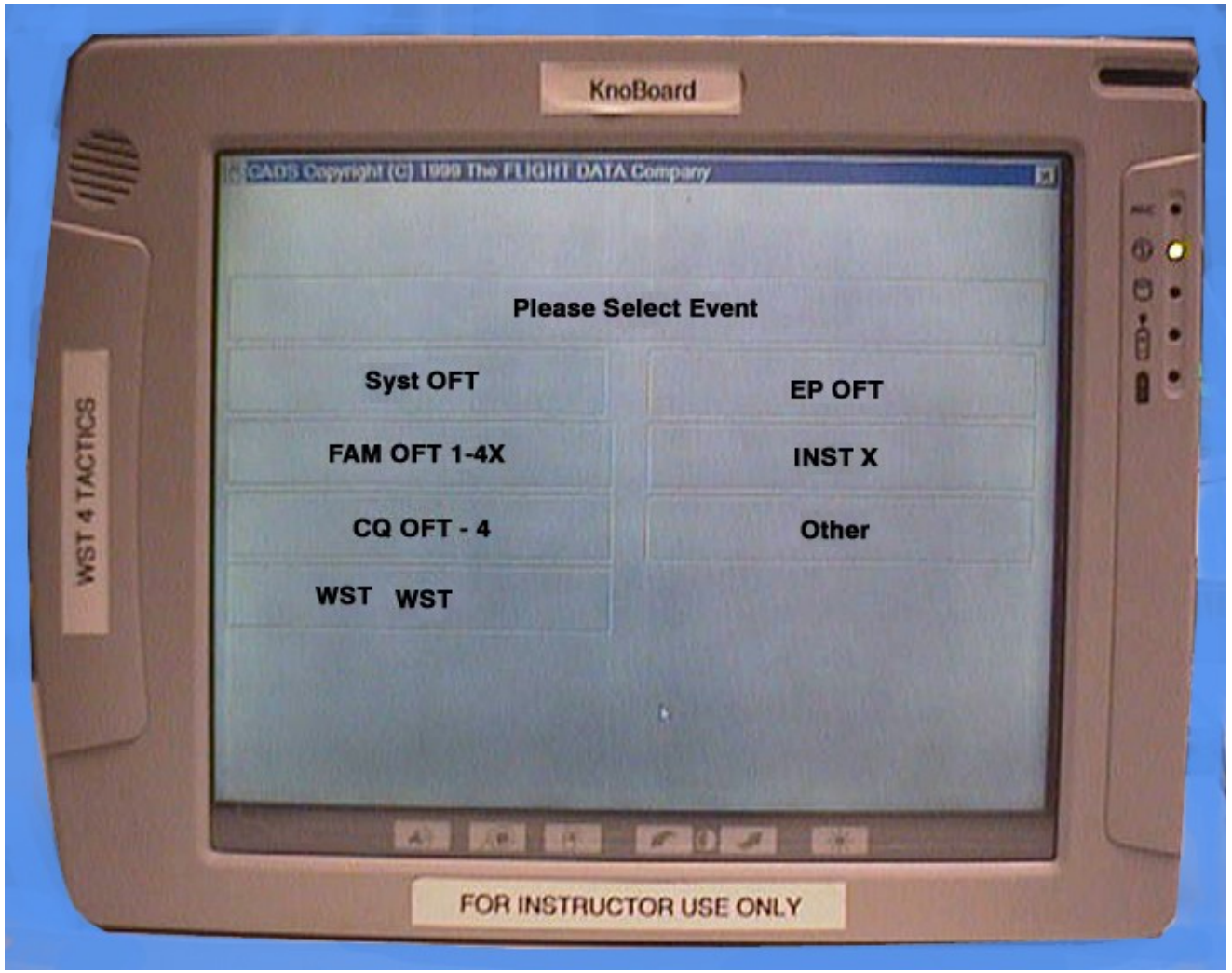
Marker Log

Replay controls

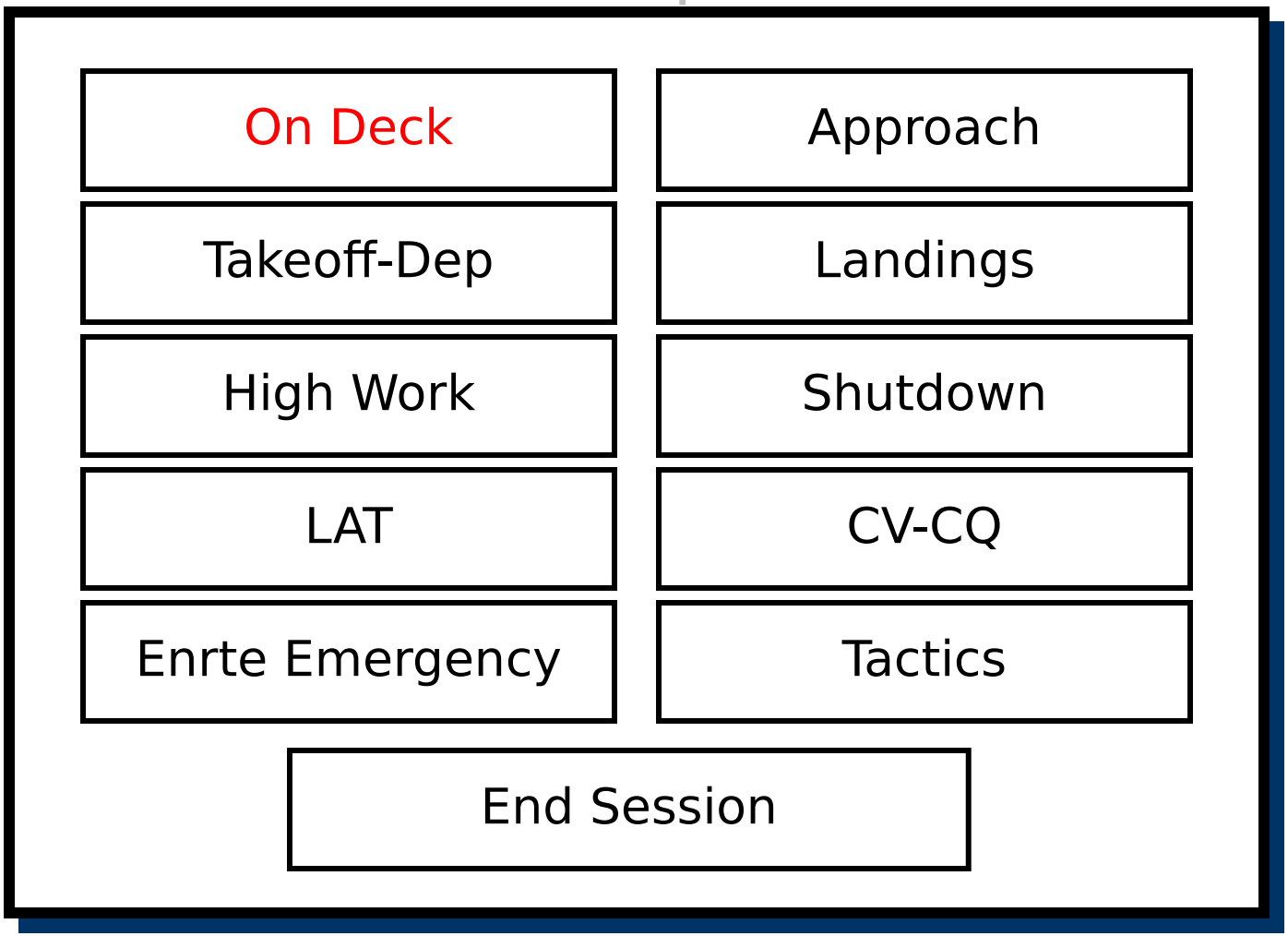
* CAPAS = Computer-Aided Performance Assessment System

CAPAS/CADS™ Interface Device Example

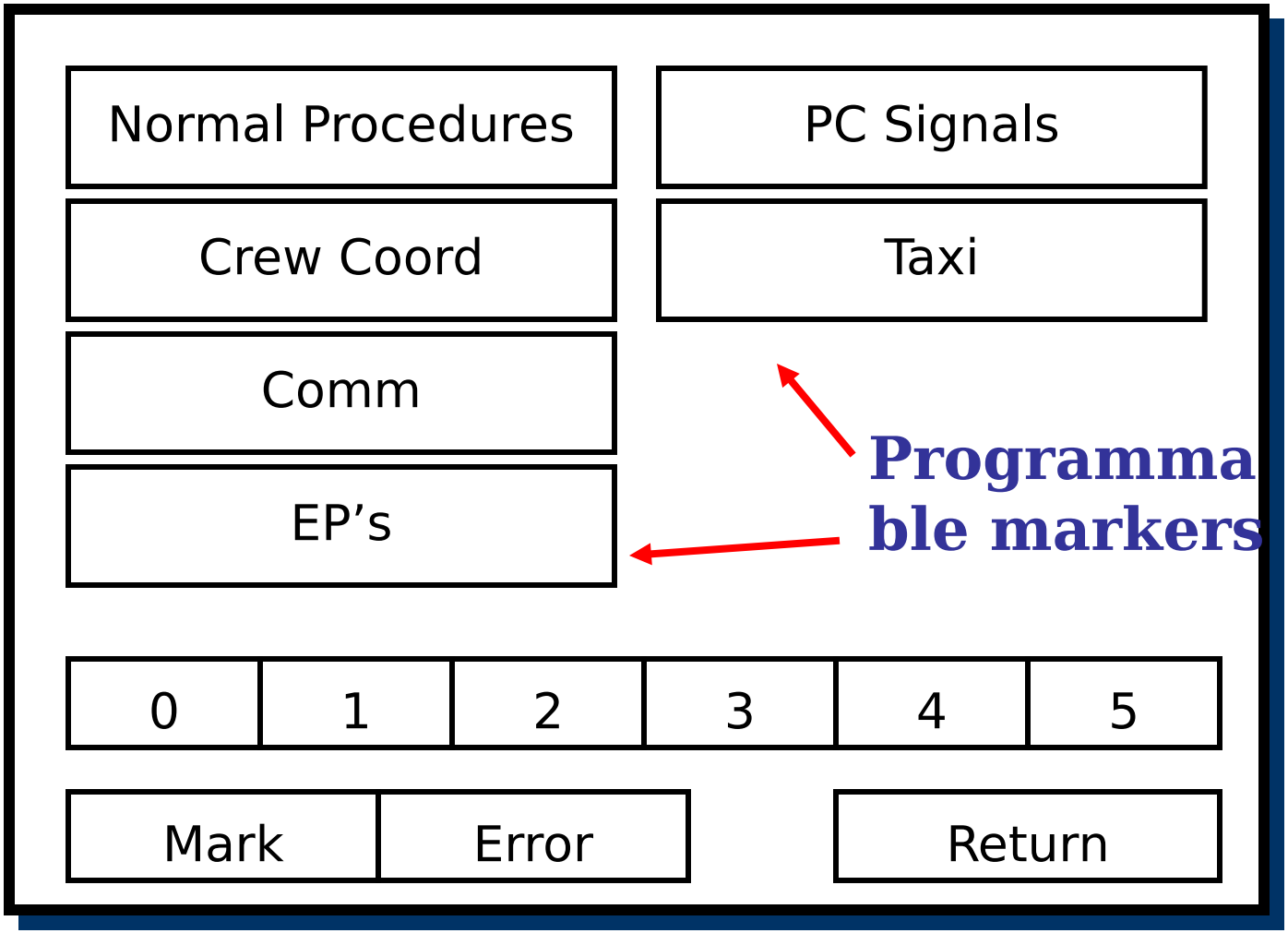
- **Hand held or Mounted**
- **Programmable**



CAPAS/CADS™ Interface Device Example



Marks within ‘On Deck’



CAPAS Usage at VS-41

- **Used to assist assessment and feedback for 18 of 29 simulator events (62%):**
  - 4 Weapon System Trainers (WST)
  - 9 Operational Flight Trainers (OFT/CQOFT)
  - 5 Tactics and Ordnance Trainers
- **System utility varies significantly with event type**
  - Most useful on CRM-intensive WST and OFT events
  - Not as useful on flight/weapon procedural trainers
- **Beyond the debrief**
  - Instructor training & standardization (“SOD/down” review)
  - Establishing an event file library for student review

CAPAS Instructor Training at VS-41

- **6+ hours of CAPAS training for IUT's**
  - Human performance (2.5 hr)
  - Debriefing and Grading (3 hrs)
  - CAPAS operation/hands on application (.5 - 1 hr)
- **Recurrent Training Usage - CADS files**
  - Instructor standardization
  - Debrief/analysis of SODs ("downs") and "gold standards"
  - "What if?" scenarios
  - *Even mundane events will provoke 10-15 min of discussion*

Planned CAPAS/CADS™ Upgrades

- Next Steps
  - Incorporate video crew de-identification software
  - Install Windows-based drag and drop editing capability (IT-21 compliant).
  - Add capability to save edited files to CD-ROM/DVD for use in classroom and stand-alone Computer-Based Training (CBT)
  - *Begin routine flight skill and CRM performance data collection and analysis.*

CAPAS Benefits

- ***Student***
  - Focused debrief - immediate access to marked learning points
  - Details facilitate self-assessment
  - Identify and correct deficient skills at earliest point; create individual performance plans
  - Access to archive of best/worst aircrew practices (de-identified)
- ***Instructor***
  - Improved instructor performance
    - Improved standardization
      - Specific evaluation criteria established and used
      - Ensure event objectives covered
      - Evaluate inter-rater reliability in grading
    - Improved use of debrief time
  - Establish and archive best instructional practices (de-identified)

CAPAS Benefits

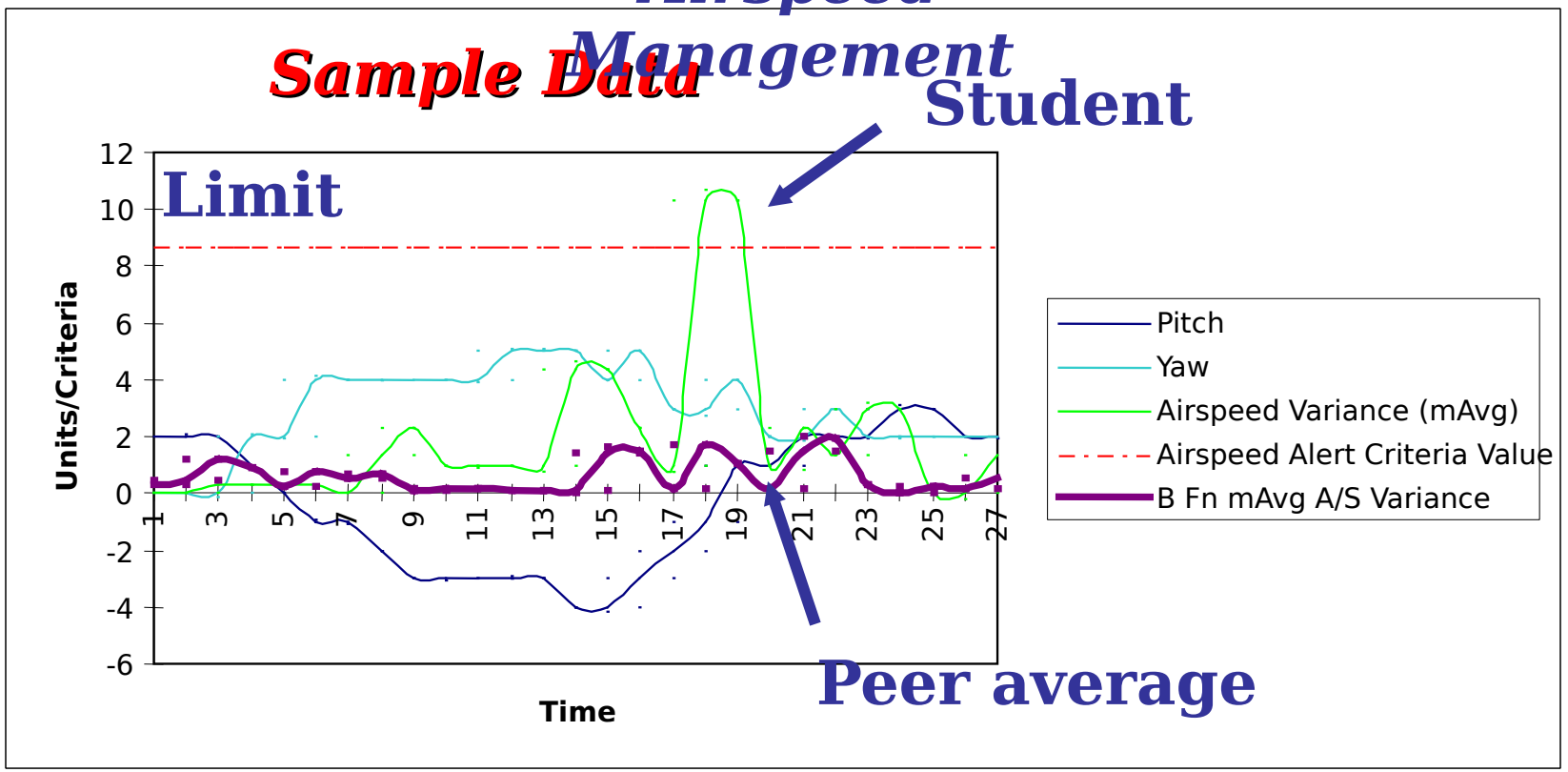
- ***Curriculum***
  - Track both individual and group training trends
  - Establish/change evaluation & performance standards
  - Enhances student/instructor focus on specific knowledge/skill/judgement
    - Identify and eliminate unnecessary objectives
    - More accurate identification of deficiencies
  - Incorporate best practices event files throughout curriculum (CBT, instructor training)

Data Collection and Assessment

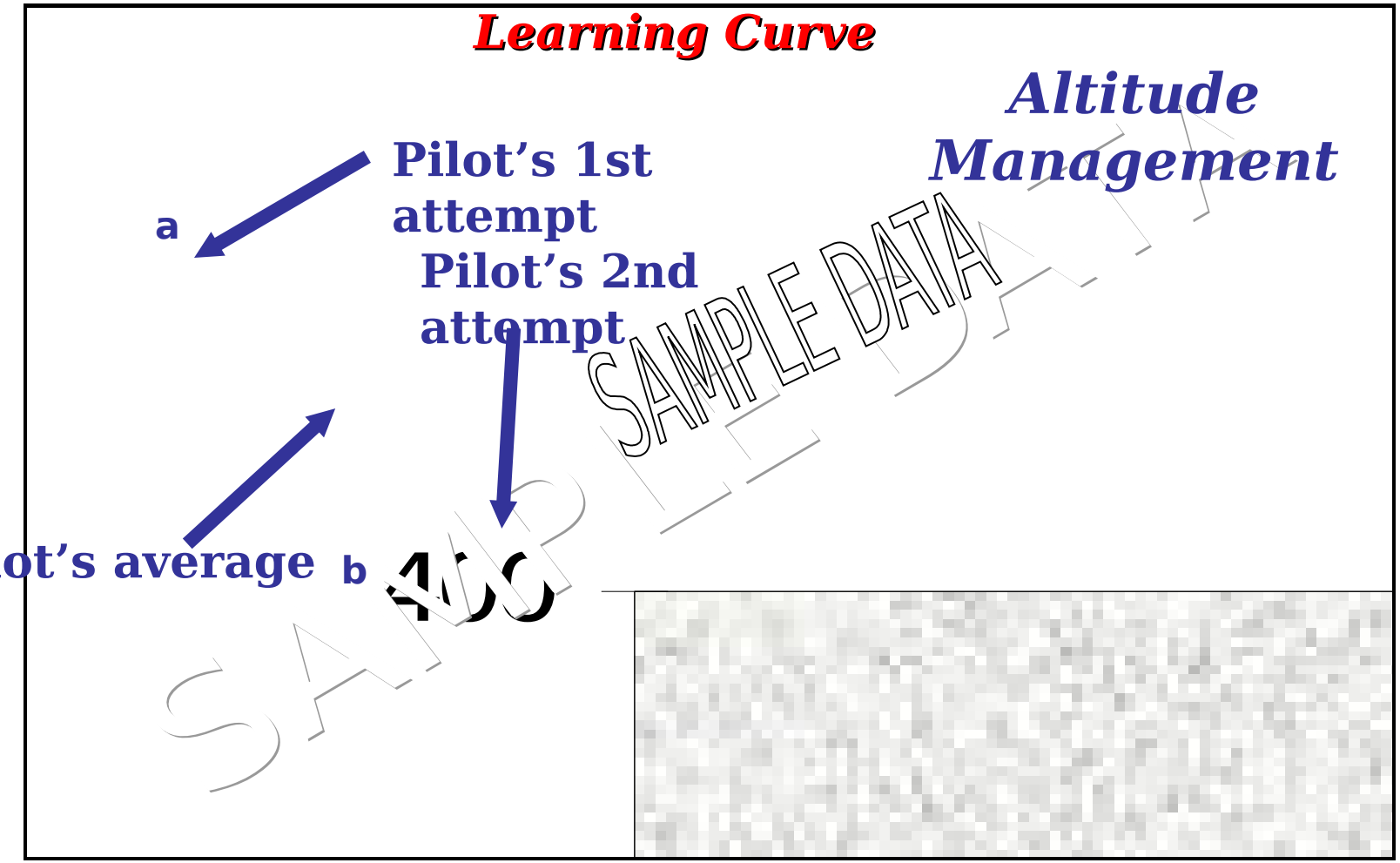
- **Map skill performance against:**
  - Established *standards*
  - Performance of *peers*
  - Previous performance *(self)*

Analyze training and ops data instead of mishap data

CAPAS Analysis Single Event



Performance Analysis



Data Collection, Assessment & Analysis

- **Aircrews, Instructors, & Training System**
  - Provide real-time detailed feedback to aircrews, instructors & training systems
  - Objective evaluation
  - Diagnose and predict performance
    - Identify behaviors/skill levels that consistently lead to successful mission performance
  - Identify rate of skill degradation
  - Define underlying/systemic problems that lead to mishaps
- **Potential for aircraft use**

Analyze training and ops data instead of mishap data

ACTC Measurement/Feedback

- **Identify behaviors and skill levels that lead to consistent, successful performance**
- **Identify skill degradation rates**
  - Provides objective measurement for T & R Matrix (periodicity)
- **Map skill development and proficiency to establish objective performance standards**
- **Provide real-time, detailed feedback to aircrews, instructors & training system**

*ACTC = Aviation Combat Training Continuum

NATOPS & SOP

- **Will benefit from data gained through current CRM program initiatives:**
  - Identify best crew behaviors/problem areas to:
    - Better define and organize critical elements of NATOPS & SOPs
  - Improved Flight Manuals and Pocket Checklists
    - Human Factors format to reduce crew errors

NATOPS Examples

Current version

OIL SYSTEM MALFUNCTIONS

***1. Throttle.....Idle; Monitor Engine Instruments**

If abnormal indications persist:

***2. Throttle.....OFF**
***3. FIRE pull handle.....Pull**
***4. Ignition switch.....OFF**
5. Generator switch.....OFF
6. APU.....Check Altitude, Airspeed/Start
7. APU automatic shutdown.....Disarm
8. APU GEN switch.....ON
9. BLEED AIR switch.....OFF
10. Hydraulic servo (if No. 2).....OFF
11. Land as soon as practicable.....Refer to Single-Engine Landing Procedure

WARNING

If the oil pressure drops to zero, the engine shall be shut down to preclude a catastrophic failure, unless safety of flight dictates otherwise.

Proposed new version

OIL SYSTEM MALFUNCTION

*1. THROTTLE - IDLE
2. ENGINE INSTRUMENTS - MONITOR

WARNING

If the oil pressure drops to zero, the engine shall be shut down to preclude a catastrophic failure, unless safety of flight dictates otherwise.

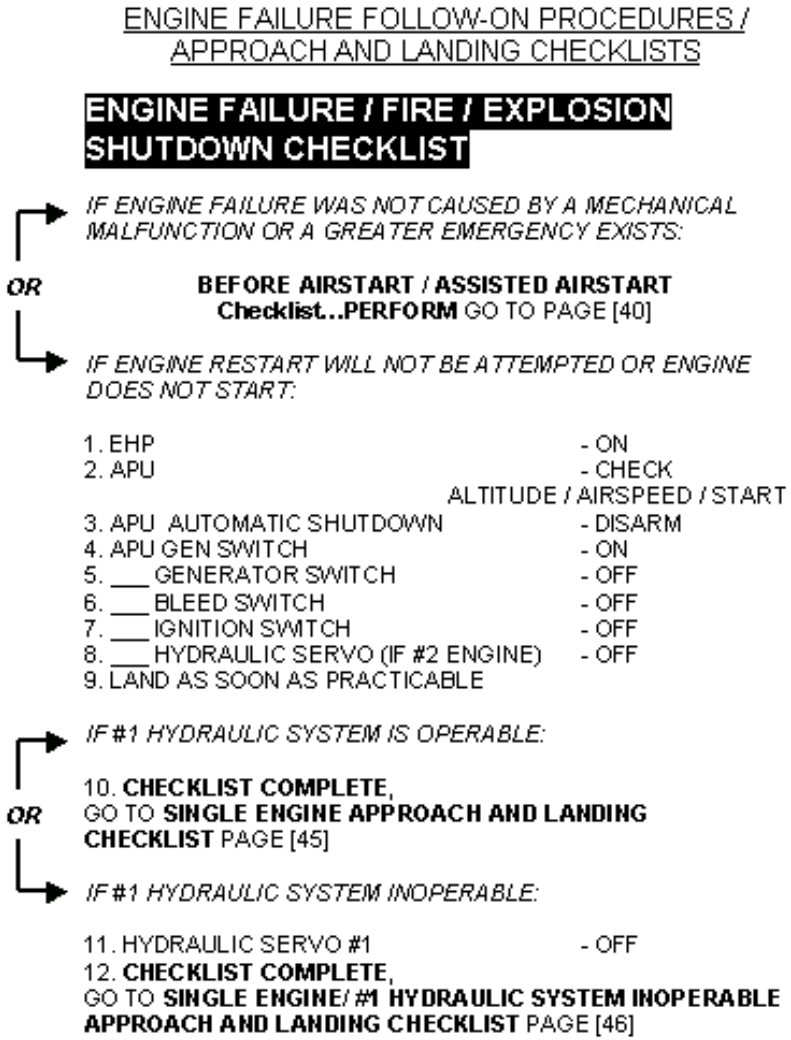
IF ABNORMAL INDICATIONS PERSIST:

3. THROTTLE - OFF
4. PRECEED TO NEAREST SUITABLE FIELD FOR LANDING
5. **IMMEDIATE ACTIONS COMPLETE**,

GO TO **ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN CHECKLIST** PAGE [16]

NATOPS Example

*Proposed new NATOPS procedures that follow-on from those in the new **OIL PRESSURE MALFUNCTION** procedure:*



ENGINE FAILURE FOLLOW-ON PROCEDURES / APPROACH AND LANDING CHECKLISTS

ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN CHECKLIST

IF ENGINE FAILURE WAS NOT CAUSED BY A MECHANICAL MALFUNCTION OR A GREATER EMERGENCY EXISTS:

OR

BEFORE AIRSTART / ASSISTED AIRSTART Checklist..PERFORM GO TO PAGE [40]

IF ENGINE RESTART WILL NOT BE ATTEMPTED OR ENGINE DOES NOT START:

1. EHP	- ON
2. APU	- CHECK
	ALTITUDE / AIRSPEED / START
3. APU AUTOMATIC SHUTDOWN	- DISARM
4. APU GEN SWITCH	- ON
5. ___ GENERATOR SWITCH	- OFF
6. ___ BLEED SWITCH	- OFF
7. ___ IGNITION SWITCH	- OFF
8. ___ HYDRAULIC SERVO (IF #2 ENGINE)	- OFF

9. LAND AS SOON AS PRACTICABLE

IF #1 HYDRAULIC SYSTEM IS OPERABLE:

OR

10. **CHECKLIST COMPLETE,**
GO TO **SINGLE ENGINE APPROACH AND LANDING CHECKLIST** PAGE [45]

IF #1 HYDRAULIC SYSTEM INOPERABLE:

11. HYDRAULIC SERVO #1	- OFF

12. **CHECKLIST COMPLETE,**
GO TO **SINGLE ENGINE/ #1 HYDRAULIC SYSTEM INOPERABLE APPROACH AND LANDING CHECKLIST** PAGE [46]

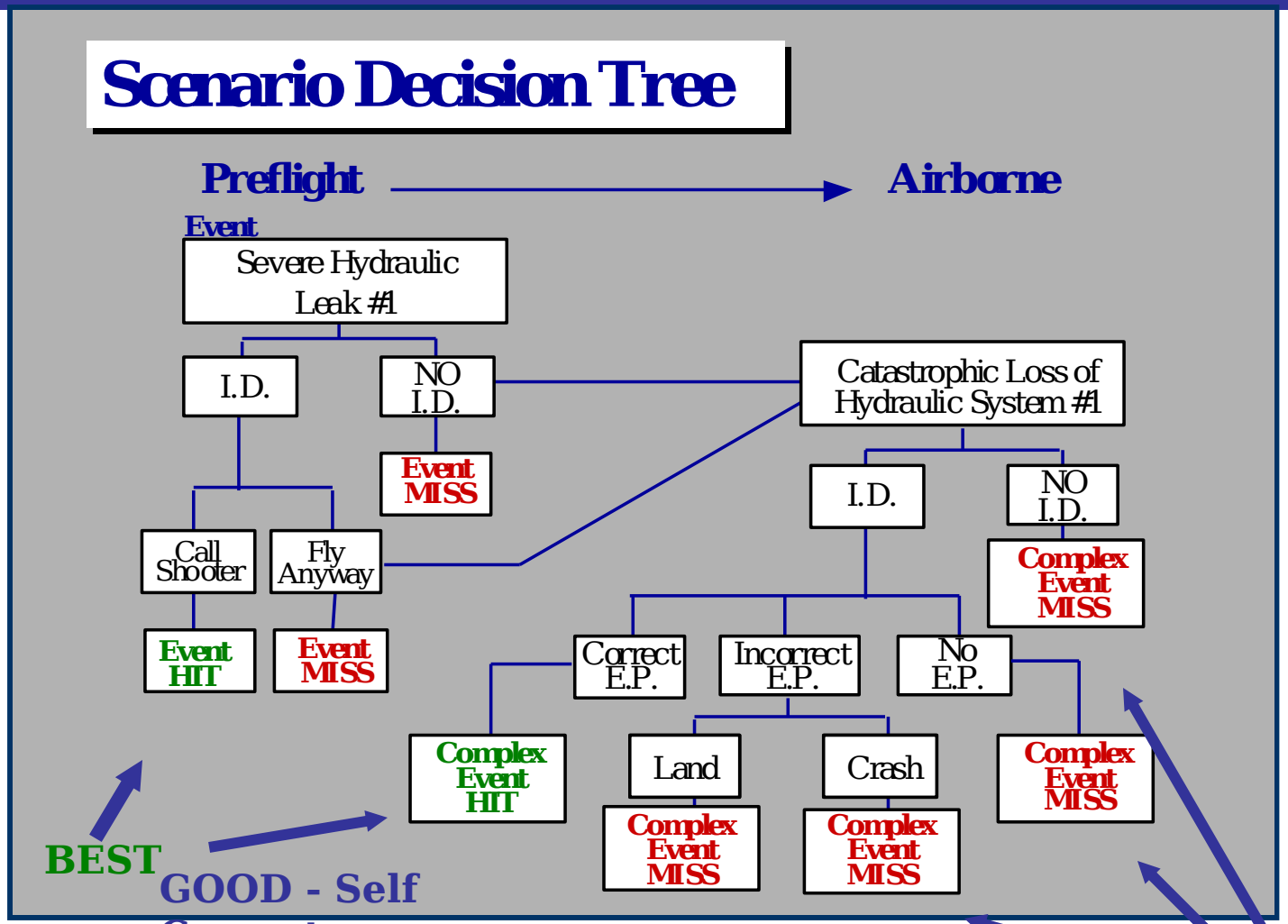
Advanced Curriculum Support

- **Advanced training concepts: instructional techniques and technology**
  - Human Factors & performance emphasis
  - Cognitive & Skill Task analysis:
    - CAPAS to capture task/mission analysis
    - Interviews to capture experiences & thought processes
  - Integrate SA and Decision Making experiences throughout curriculum
    - Lectures, CBT, brief, debrief, evaluations
  - Design curriculum for systematic data collection

Scenario Design/Development

- **Assess skills for effective flight performance and priority of decisions**
  - Address mishap/HAZREP causal factors, tactical and flight performance
  - Create models that correlate crew processes (MOP) to best performance (MOE).
  - Trigger performance against a measurable standard
  - Flight precision skill (stick and rudder)
  - Decision skills (ORM/CRM, NATOPS procedures, SOP, tactical procedures)

Event-Based Scenario



Flight Instructor Training

- **Five-day course with practical application**
  - Instructor Team (Ed Spec, CSI, Stan, Curriculum)
  - Human factors integration
  - Instructional techniques & standardization
  - Scenario development
  - Crew evaluation and feedback
  - Decision skills facilitation
- **Assessing Human Performance**
- **Use CAPAS recordings (best & worst)**
  - Practice evaluating instructional techniques and grading events

Flight Instructor Training

- **<u>Ongoing</u> instructor performance data collection and feedback:**
  - Training objectives covered? (Time/quality)
  - Grading criteria used specific to event?
  - Quality of instruction, evaluation and crew performance feedback

Aviator SA/Decision Skills Training

- ***Adaptive Decision Making*** in uncertain, time-constrained situations
- Focuses instructors & crews on critical thinking and problem solving
- Developing plans *and* solutions to realistic situations
- Instructors generate realistic scenarios geared to trigger decisions in various training events (classroom, trainer and in-flight)

Increase versatility in thinking

Aviator SA/Decision Skills Training

- Applies across spectrum of training and operations
- Captures, reinforces & extends thinking skills
- Builds on experience base
  - Practice making decisions in context
  - Develop/enhance pattern recognition skills (SA)
- Facilitates crew self-evaluation
- Maximizes instructor/student interaction

Optimize Decision Making Under Pressure

Integrated CRM Example

* CRM = Crew Resource Management

In Summary

- CRM training implementation plan integrating:
  - ***CAPAS hardware, software and analysis***
    - Leverage advances in IT to scientifically and systematically improve training and readiness
  - ***Flight Instructor and decision skills training***
    - Increase depth and broaden experience level
  - ***Curriculum development training and tools***
    - Better defines MOP and MOE for more relevant training, assessment, and feedback

CRM/ORM Becomes a Practice ...Not a Program

* CRM = Crew Resource Management

Points of Contact

- Naval Air Board Human Factors QMB, Training Improvements Working Group

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